

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 08-217484

(43)Date of publication of application : 27.08.1996

(51)Int.Cl.	C03C 3/068
	C03C 3/15
	C03C 3/155
	G02B 1/02

(21)Application number : 07-047731

(71)Applicant : OHARA INC

(22)Date of filing : 13.02.1995

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(54) OPTICAL GLASS

(57)Abstract:

PURPOSE: To obtain optical glass having optical constant comprising 1.65-1.90 refractive index and 35-65 Abbe's number and exhibiting devitrification resistance enough to mass-produce by limiting the component composition, using B₂O₃, La₂O₃, Lu₂O₃ and RO necessary component and specifying other components, refractive index and Abbe's number.

CONSTITUTION: This optical glass contains components comprising 1-45wt.% B₂O₃, 0-30wt.% SiO₂ and 0-10wt.% GeO with the proviso that total amount of B₂O₃+SiO₂+GeO₂ is 10-45wt.%, 1-50wt.% La₂O₃, 0.5-30wt.% Lu₂O₃, 0-20wt.% Y₂O₃, 0-20wt.% Gd₂O₃ and 0-20wt.% Yb₂O₃ with the proviso that total amount of La₂O₃+Lu₂O₃+Y₂O₃+Gd₂O₃+Yb₂O₃ is 15-64wt.%, 1-45wt.% RO (R is Zn, Mg, Ca, Sr or Ba), 0-5wt.% Al₂O₃, 0-20wt.% total amount of TiO₂+ZrO₂, 0-40wt.% total amount of Ta₂O₅+Nb₂O₅+WO₃, 0-20wt.% R'₂O (R' is Li, Na or K) and 0-2wt.% Sb₂O₃ and having optical constant comprising 1.65-1.90 refractive index (nd) and 35-65 Abbe's number.

LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's
decision of rejection]

[Date of requesting appeal against examiner's
decision of rejection]

[Date of extinction of right]

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CLAIMS

[Claim(s)]

[Claim 1] By weight %, B₂O₃ 1 - 45%, SiO₂ 0 - 30%, GeO₂ The total quantity of 0 - 10%, however B₂O₃+SiO₂+GeO₂ 10 - 45%, La₂O₃ 1 - 50%, Lu₂O₃ 0.5 - 30%, Y₂O₃ 0 - 20%, Gd₂O₃ 0 - 20%, Yb₂O₃ The total quantity of 0 - 20%, however La₂O₃+Lu₂O₃+Y₂O₃+Gd₂O₃+Yb₂O₃ 15 - 65%, RO (however, R=Zn, Mg, calcium, Sr, Ba) 1 - 45%, aluminum₂O₃ 0 - 0 - 20% of total quantities of 5% and TiO₂+ZrO₂, the total quantity of Ta₂O₅+Nb₂O₅+WO₃ 0 - 40%, R'₂O (however, R'=Li, Na, K) 0 - 10%, Sb₂O₃ 0- Optical glass with which each component of 2%** is contained, and a refractive index (nd) is characterized by 1.65-1.90, and the Abbe number (nud) having the optical constant of the range of 35-65.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the optical glass with which 1.65-1.90, and the Abbe number (n_D) have [a refractive index (n_D)] the optical constant of the range of 35-65.

[0002]

[Description of the Prior Art] The glass which used B-2s La [O₃ and] 2O₃ as the principal component from the former as optical glass which has said optical constant is known variously. For example, B-2O₃-SiO₂-La₂O₃-BaO-ZrO₂ system, B-2O₃-La₂O₃-Gd₂O₃-RO, and/or 2Oaluminum₃ system (RO is a divalent metal oxide), Glass, such as B-2O₃-SiO₂-La₂O₃-Y₂O₃-ZrO₂-Ta₂O₅ system and/or a B-2O₃-SiO₂-La₂O₃-Y₂O₃-ZrO₂-ZnO system, and a B-2O₃-La₂O₃-Y₂O₃-RO-Li₂O system, is proposed in each official report, such as JP,51-34914,A, JP,48-61517,A, JP,52-48609,B, JP,55-116641,A, and JP,60-221338,A, respectively. Generally, since these glass is inferior to devitrification-proof nature, found in said each official report, no glass has enough importance also in the improvement of devitrification-proof nature, and development of the glass which was further excellent in devitrification-proof nature on glass shaping is desired.

[0003]

[Problem(s) to be Solved by the Invention] This invention has a refractive index (n_D) in offering the optical glass in which the stability (devitrification-proof nature) over sufficient devitrification for 1.65-1.90, and the Abbe number (n_D) to be able to mass-produce with the optical constant of the range of 35-65 is shown.

[0004]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, maintaining said optical constant in the B-2O₃-La₂O₃-Lu₂O₃-RO system glass of the specific range, as a result of repeating test research wholeheartedly, this invention person finds out that the devitrification-proof nature which was excellent much more is shown, and came to make this invention.

[0005] The description of the optical glass concerning this invention is weight %. B-2 O₃ 1 - 45%, SiO₂ 0 - 30%, GeO₂ The total quantity of 0 - 10%, however B-2O₃+SiO₂+GeO₂ 10 - 45%, La₂O₃ 1 - 50%, Lu₂O₃ 0.5 - 30%, Y₂O₃ 0 - 20%, Gd₂O₃ 0 - 20%, Yb₂O₃ 15 - 65% of total quantities of 0 - 20%, however La₂O₃+Lu₂O₃+Y₂O₃+Gd₂O₃+Yb₂O₃, RO (however, R=Zn, Mg, calcium, Sr, Ba) 1 - 45%, aluminum 2O₃ 0 - 20% of total quantities of 5% and TiO₂+ZrO₂, the total quantity of Ta₂O₅+Nb₂O₅+WO₃ 0 - 40%, R'₂O (however, R'=Li, Na, K) 0 - 10%, Sb₂O₃ 0- It is in containing each component of 2%**.

[0006] Especially the B-2O₃-La₂O₃-Lu₂O₃-RO system glass by this invention has the description in the point constituted by B-2O₃-La₂O₃-RO system glass based on the knowledge which is not in the conventional technique in which it is very important to make 2OLu₃ component live together among various components in the above-mentioned purpose achievement.

[0007] Next, the reason which limited the presentation range of each component is explained as above-mentioned. In the optical glass of this invention, the chemical durability of glass deteriorates at the same

time homogeneous glass will no longer be obtained by volatilization of B-2O₃ component if the devitrification inclination of glass increases that the amount of B-2O₃ component is less than 1% and it exceeds 45% although each component of B-2s O₃, SiO₂, and GeO₂ is a glass formation component among those. Again, If the amount of SiO₂ component exceeds 30%, it will become difficult to get about glass homogeneous from soluble aggravation. Although GeO₂ component can furthermore be added for optical constant adjustment, even 10% is enough as the amount. When one sort or two sorts or more of total quantities, B-2s O₃ and SiO₂ and GeO₂ each component, are required 10% or more because of devitrification prevention of glass and the total quantity of these components exceeds 45%, it becomes impossible however, to maintain a target optical constant.

[0008] Although 2OLa₃ component is a component effective in giving the aforementioned optical constant to glass, if the devitrification-proof nature improvement effect of glass according [the amount] to coexistence with Lu 2O₃ is not fully acquired but exceeds 50%, at less than 1%, it will on the contrary become easy to devitrify glass.

[0009] Although it is the important component which found out that 2OLu₃ component expanded the vitrification range, and showed better devitrification-proof nature by making it coexist with 2OLa₃ component in the glass of this invention, if less than 0.5% of the effectiveness is not enough as the amount and the amount exceeds 30%, it will on the contrary become easy to devitrify glass.

[0010] Each component of Y₂O₃, Gd₂O₃, and Yb₂O₃ is a component effective in giving said optical constant to glass, and glass excellent in devitrification-proof nature is obtained by multicomponent-izing a glass presentation together with La 2O₃ and Lu₂O₃. However, in order to acquire many above-mentioned effectiveness, it is required to make two or more sorts of total quantities of the these 5 components 15% or more. Moreover, if the amount of these components exceeds 65%, it will on the contrary become easy to devitrify glass.

[0011] Although each component of ZnO, MgO, CaO, SrO, and BaO is effective in raising the devitrification-proof nature of glass, and homogeneity, in order to acquire many above-mentioned effectiveness of these divalent metal oxide component, one sort or two sorts or more of total quantities of these components are required for it 1% or more. However, if the amount of these components exceeds 45%, the chemical durability of glass will get worse remarkably.

[0012] Although 2Oaluminum₃ component can be added to arbitration for the chemical durability improvement of glass, even 5% is enough as the amount.

[0013] Although each component of TiO₂ and ZrO₂ can be added to arbitration for the chemical durability improvement of glass, and optical constant adjustment, if one sort or two sorts of total quantities of these components exceed 20%, it will become easy to devitrify glass.

[0014] Although each component of Ta 2O₅, Nb₂O₅, and WO₃ can be added to arbitration for the devitrification-proof nature improvement of glass, and optical constant adjustment, if one sort or two sorts or more of total quantities of these components exceed 40%, it will become easy to devitrify glass.

[0015] Although each component of Li₂O, Na₂O, and K₂O can be added for the melting nature improvement of glass, if one sort or two sorts or more of total quantities of these components exceed 10%, chemical durability will get worse remarkably.

[0016] Although 2OSb₃ component can be added to arbitration as a clarifier in the case of melting of glass, 2% or less is enough as the amount.

[0017] in addition, the glass of this invention -- components other than the above, for example, F and Bi 2O₃, and HfO₂ and Cs₂ -- even if it adds if needed for the improvement of adjustment of an optical constant, the solubility of glass, and devitrification nature to about a total of 3% of components, such as O and SnO, it does not interfere.

[0018]

[Example] Next, it was shown in Table 1 with the refractive index (nd) of the glass obtained, respectively about the example of an operation presentation concerning the optical glass of this invention (No.1-No.10), and the example of a comparison presentation of said conventional optical glass (No.11-No.13), the Abbe number (nud), and the measurement result of a devitrification trial.

[0019] A devitrification trial is a trial for the devitrification generated at the time of glass shaping, and

80g of glass samples is paid to 50 cc pot made from platinum. After lowering the temperature after fusing each sample at the temperature of 1100-1300 degrees C for 2 hours according to the difficulty of the melting nature of each glass in an electric furnace, and keeping each sample warm for 2 hours at 1000 degrees C, 975 degrees C, and 950 degrees C, it is what took out outside the furnace and observed the existence of devitrification under the microscope. Consequently, x mark showed the glass, as for the glass with which devitrification is not accepted, devitrification was accepted to be by O mark again.

[0020]

[Table 1]

単位：重量%

	実 施 例				
	1	2	3	4	5
SiO ₂	30.0	15.0		2.0	20.0
B ₂ O ₃	1.0	5.0	10.0	10.0	20.0
GeO ₂				10.0	
La ₂ O ₃	1.0	10.0	10.0	40.0	28.0
Lu ₂ O ₃	30.0	5.0	18.0	5.0	2.0
Y ₂ O ₃					
Gd ₂ O ₃				10.0	
Yb ₂ O ₃					
ZnO				1.0	5.0
MgO		3.0			
CaO	10.0		4.0		5.0
SrO		7.0			3.0
BaO	10.0		41.0		5.0
Al ₂ O ₃	1.0		5.0		0.5
TiO ₂	3.6	20.0	7.0		
ZrO ₂	6.5		3.0	2.5	7.5
Ta ₂ O ₅				18.5	
Nb ₂ O ₅	4.9	22.0		1.0	
WO ₃		3.0	1.0		
Li ₂ O	1.0		1.0		4.0
Na ₂ O		5.0			
K ₂ O		5.0			
Sb ₂ O ₃	1.0				
nd	1.665	1.876	1.741	1.856	1.692
νd	42.7	35.2	37.5	40.9	51.6
失透試験	1000℃	○	○	○	○
	975℃	○	○	○	○
	950℃	○	○	○	○

[Table 1]

単位；重量%

		実 施 例				
		6	7	8	9	10
SiO ₂			5.0		6.0	
B ₂ O ₃		20.0	25.0	28.0	30.0	45.0
GeO ₂				5.0		
La ₂ O ₃		17.0	50.0	20.0	23.5	29.0
Lu ₂ O ₃		3.0	0.5	20.0	1.5	1.0
Y ₂ O ₃		2.0		7.0	6.0	10.0
Gd ₂ O ₃		2.0				5.0
Yb ₂ O ₃		2.0	14.5	3.0		
ZnO					23.1	5.0
MgO						
CaO				5.0		
SrO						
BaO		6.5	1.0			
Al ₂ O ₃		2.5				
TiO ₂					0.1	
ZrO ₂			3.9		6.0	2.0
Ta ₂ O ₅						
Nb ₂ O ₅		40.0				
WO ₃				5.0		
Li ₂ O				5.0	3.3	3.0
Na ₂ O						
K ₂ O		5.0				
Sb ₂ O ₃			0.1	2.0	0.5	
nd		1.899	1.779	1.729	1.708	1.691
vd		38.0	47.7	52.5	48.9	56.8
失速試験	1000℃	○	○	○	○	○
	975℃	○	○	○	○	○
	950℃	○	○	○	○	○

[Table 1]

単位：重量%

	比較例		
	1 1	1 2	1 3
SiO ₂	2.0	20.0	
B ₂ O ₃	10.0	20.0	45.0
GeO ₂	10.0		
La ₂ O ₃	45.0	28.0	1.0
Lu ₂ O ₃			
Y ₂ O ₃			10.0
Gd ₂ O ₃	10.0	2.0	5.0
Yb ₂ O ₃			
ZnO	1.0	5.0	5.0
MgO			
CaO		5.0	
SrO		3.0	
BaO		5.0	
Al ₂ O ₃		0.5	
TiO ₂			
ZrO ₂	2.5	7.5	2.0
Ta ₂ O ₅	18.5		
Nb ₂ O ₅	1.0		
WO ₃			
Li ₂ O		4.0	3.0
Na ₂ O			
K ₂ O			
Sb ₂ O ₃			
nd	1.857	1.690	1.693
νd	40.9	51.8	56.9
失透試験	1000℃	○	○
	975℃	×	○
	950℃	×	×

[0021] Each glass of the example of this invention has said predetermined optical constant as it sees in Table 1. Moreover, compared with the glass of the example of a comparison of No.11-No.13 which does not contain Lu₂O₃, each of these glass is excellent in devitrification-proof nature, and it is further easy to homogenize it. For this reason, the glass of said example is easy to manufacture. In addition, after the glass of the example of an operation presentation of this invention given in Table 1 all carries out weighing capacity mixing at a predetermined rate using the usual optical-glass raw materials, such as an oxide, a carbonate, and a nitrate, it is thrown into platinum crucible, after fusing for 2 to 4 hours and carrying out stirring homogenization at the temperature of 1000-1300 degrees C according to the difficulty of melting by presentation, can be lowered to suitable temperature and can be easily obtained by casting and cooling slowly to metal mold etc.

[0022]

[Effect of the Invention] Since the optical glass of this invention has the specific presentation of a B-2O₃-La₂O₃-Lu₂O₃-RO system, the glass with which a refractive index (nd) has [1.65-1.90, and the Abbe number (νd)] the devitrification-proof nature which was excellent much more compared with the optical constant of the range of 35-65 and conventional glass is obtained as stated above.

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CONSTITUTION: This optical glass contains components comprising 1–45wt.% B₂O₃, 0–30wt.% SiO₂ and 0–10wt.% GeO with the proviso that total amount of B₂O₃+SiO₂+GeO₂ is 10–45wt.%, 1–50wt.% La₂O₃, 0.5–30wt.% Lu₂O₃, 0–20wt.% Y₂O₃, 0–20wt.% Gd₂O₃ and 0–20wt.% Yb₂O₃ with the proviso that total amount of La₂O₃+Lu₂O₃+Y₂O₃+Gd₂O₃+Yb₂O₃ is 15–64wt.%, 1–45wt.% RO (R is Zn, Mg, Ca, Sr or Ba), 0–5wt.% Al₂O₃, 0–20wt.% total amount of TiO₂+ZrO₂, 0–40wt.% total amount of Ta₂O₅+Nb₂O₅+WO₃, 0–20wt.% R'₂O (R' is Li, Na or K) and 0–2wt.% Sb₂O₃ and having optical constant comprising 1.65–1.90 refractive index (nd) and 35–65 Abbe's number.

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[Number of appeal against examiner's decision of rejection]

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[Date of extinction of right]

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(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開平8-217484

(43) 公開日 平成8年(1996)8月27日

(51) Int.Cl. ⁶	識別記号	庁内整理番号	F I	技術表示箇所
C 0 3 C	3/068		C 0 3 C 3/068	
	3/15		3/15	
	3/155		3/155	
G 0 2 B	1/02		G 0 2 B 1/02	

審査請求 未請求 請求項の数 1 F D (全 6 頁)

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(54) 【発明の名称】 光学ガラス

(57) 【要約】

【目的】 本発明は、屈折率 (n_d) が 1.65 ~ 1.90、アッベ数 (ν_d) が 35 ~ 65 の範囲の光学恒数を有し、かつ、失透に対する十分なる安定性を示す光学ガラスを提供することにある。

【構成】 必須成分が重量%で、B₂O₃ 1 ~ 45%、La₂O₃ 1 ~ 50%、Lu₂O₃ 0.5 ~ 30%、R O (ただし、R = Zn、Mg、Ca、Sr、Ba) 1 ~ 45% から成る。

【特許請求の範囲】

【請求項 1】 重量%で、 B_2O_3 1~45%、 SiO_2 0~30%、 GeO_2 0~10%、ただし、 $B_2O_3+SiO_2+GeO_2$ の合計量 10~45%、 La_2O_3 1~50%、 Lu_2O_3 0.5~30%、 Y_2O_3 0~20%、 Gd_2O_3 0~20%、 Yb_2O_3 0~20%、ただし、 $La_2O_3+Lu_2O_3+Y_2O_3+Gd_2O_3+Yb_2O_3$ の合計量 15~65%、 RO （ただし、 $R=Zn, Mg, Ca, Sr, Ba$ ） 1~45%、 Al_2O_3 0~5%、 TiO_2+ZrO_2 の合計量 0~20%、 $Ta_2O_5+Nb_2O_5+WO_3$ の合計量 0~40%、 R'_2O （ただし、 $R'=Li, Na, K$ ） 0~10%、 Sb_2O_3 0~2%、の各成分を含有し、かつ、屈折率（ n_d ）が1.65~1.90、アッペ数（ v_d ）が35~65の範囲の光学恒数を有することを特徴とする光学ガラス。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、屈折率（ n_d ）が1.65~1.90、アッペ数（ v_d ）が35~65の範囲の光学恒数を有する光学ガラスに関する。

【0002】

【従来の技術】従来から、前記光学恒数を有する光学ガラスとしては B_2O_3 および La_2O_3 を主成分としたガラスが種々知られている。例えば、 $B_2O_3-SiO_2-La_2O_3-BaO-ZrO_2$ 系、 $B_2O_3-La_2O_3-Gd_2O_3-RO$ および／または Al_2O_3 系（ RO は2価金属酸化物）、 $B_2O_3-SiO_2-La_2O_3-Y_2O_3-ZrO_2-Ta_2O_5$ 系および／または $B_2O_3-SiO_2-La_2O_3-Y_2O_3-ZrO_2-ZnO$ 系、 $B_2O_3-La_2O_3-Y_2O_3-RO-Li_2O$ 系等のガラスが、それぞれ特開昭51-34914号、特開昭48-61517号、特公昭52-48609号、特開昭55-116641号および特開昭60-221338号等の各公報において提案されている。一般的にこれらのガラスは耐失透性に劣っていることから、前記各公報に掲載のガラスはいずれも耐失透性の改善に重点がおかれているが十分ではなく、ガラス成形上さらに耐失透性に優れたガラスの開発が望まれている。

【0003】

【発明が解決しようとする課題】本発明は、屈折率（ n_d ）が1.65~1.90、アッペ数（ v_d ）が35~65の範囲の光学恒数と大量生産し得るに十分な失透に対する安定性（耐失透性）を示す光学ガラスを提供することにある。

【0004】

【課題を解決するための手段】上記目的を達成するために本発明者は、鋭意試験研究を重ねた結果、特定範囲の $B_2O_3-La_2O_3-Lu_2O_3-RO$ 系ガラスにおいて、

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前記光学定数を維持しつつ、一段と優れた耐失透性を示すことを見だし、本発明をなすに至った。

【0005】本発明にかかる光学ガラスの特徴は、重量%で、 B_2O_3 1~45%、 SiO_2 0~30%、 GeO_2 0~10%、ただし、 $B_2O_3+SiO_2+GeO_2$ の合計量 10~45%、 La_2O_3 1~50%、 Lu_2O_3 0.5~30%、 Y_2O_3 0~20%、 Gd_2O_3 0~20%、 Yb_2O_3 0~20%、ただし、 $La_2O_3+Lu_2O_3+Y_2O_3+Gd_2O_3+Yb_2O_3$ の合計量 15~65%、 RO （ただし、 $R=Zn, Mg, Ca, Sr, Ba$ ） 1~45%、 Al_2O_3 0~5%、 TiO_2+ZrO_2 の合計量 0~20%、 $Ta_2O_5+Nb_2O_5+WO_3$ の合計量 0~40%、 R'_2O （ただし、 $R'=Li, Na, K$ ） 0~10%、 Sb_2O_3 0~2%、の各成分を含有することにある。

【0006】本発明による $B_2O_3-La_2O_3-Lu_2O_3-RO$ 系ガラスは、上記目的達成に当たり、 $B_2O_3-La_2O_3-RO$ 系ガラスに、種々の成分中、とくに Lu_2O_3 成分を共存させることがきわめて重要であるという従来技術にない知見にもとづいて構成されている点に特徴がある。

【0007】次に、上記のとおり、各成分の組成範囲を限定した理由について述べる。本発明の光学ガラスにおいて、 B_2O_3 、 SiO_2 および GeO_2 の各成分は、ガラス形成成分であるが、そのうち B_2O_3 成分の量が1%未満であるとガラスの失透傾向が増大し、また45%を超えると B_2O_3 成分の揮発により均質なガラスが得られなくなると同時に、ガラスの化学的耐久性が劣化する。また、 SiO_2 成分の量が30%を超えると溶解性の悪化から均質なガラスを得難くなる。さらに GeO_2 成分は光学恒数調整のため添加し得るが、その量は10%までで十分である。しかし B_2O_3 、 SiO_2 および GeO_2 各成分の1種または2種以上の合計量はガラスの失透防止のため10%以上必要であり、またこれらの成分の合計量が45%を超えると目標の光学恒数を維持できなくなる。

【0008】 La_2O_3 成分は、前記の光学恒数をガラスに与えるのに有効な成分であるが、その量が1%未満では、 Lu_2O_3 との共存によるガラスの耐失透性改善効果が十分に得られず、50%を超えるとガラスはかえって失透しやすくなる。

【0009】 Lu_2O_3 成分は、本発明のガラスにおいて La_2O_3 成分と共存させることによってガラス化範囲を拡大し、一段と良好な耐失透性を示すことを見出した重要な成分であるが、その量が0.5%未満では、その効果が十分でなく、また、その量が30%を超えると、ガラスはかえって失透しやすくなる。

【0010】 Y_2O_3 、 Gd_2O_3 および Yb_2O_3 の各成分

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は、前記光学恒数をガラスに与えるのに有効な成分であり、 La_2O_3 および Lu_2O_3 と合わせてガラス組成を多成分化することにより、耐失透性に優れたガラスが得られる。しかし、上記の諸効果を得るためには、これら5成分のうちの2種以上の合計量を15%以上にする必要がある。またこれらの成分の量が65%を超えるとガラスはかえって失透しやすくなる。

【0011】 ZnO 、 MgO 、 CaO 、 SrO および BaO の各成分は、ガラスの耐失透性や均質性を向上させる効果があるが、これら2価金属酸化物成分の上記諸効果を得るためには、これらの成分の1種または2種以上の合計量が1%以上必要である。しかし、これらの成分の量が45%を超えるとガラスの化学的耐久性が著しく悪化する。

【0012】 Al_2O_3 成分は、ガラスの化学的耐久性改善のために任意に添加し得るが、その量は5%までで十分である。

【0013】 TiO_2 、 ZrO_2 の各成分は、ガラスの化学的耐久性改善および光学恒数調整のため任意に添加し得るが、これらの成分の1種または2種の合計量が20%を超えるとガラスは失透しやすくなる。

【0014】 Ta_2O_5 、 Nb_2O_5 および WO_3 の各成分は、ガラスの耐失透性改善および光学恒数調整のため任意に添加し得るが、これらの成分の1種または2種以上の合計量が40%を超えるとガラスは失透しやすくなる。

【0015】 Li_2O 、 Na_2O 、 K_2O の各成分はガラスの熔融性改善のために添加し得るが、これらの成分の

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1種または2種以上の合計量が10%を超えると化学的耐久性が著しく悪化する。

【0016】 Sb_2O_3 成分はガラスの熔融の際の清澄剤として任意に添加し得るが、その量は2%以下で十分である。

【0017】なお、本発明のガラスに上記以外の成分、例えば F 、 Bi_2O_3 、 HfO_2 、 Cs_2O および SnO 等の成分の合計3%程度まで、光学恒数の調整、ガラスの溶解性および失透性の改善のため必要に応じ添加してもさしつかえない。

【0018】

【実施例】次に、本発明の光学ガラスにかかる実施組成例(No. 1~No. 10)および前記従来の光学ガラスの比較組成例(No. 11~No. 13)についてそれぞれ得られたガラスの屈折率(n_d)、アッペ数(v_d)および失透試験の測定結果とともに表1に示した。

【0019】失透試験はガラス成形時に発生する失透を対象とした試験であり、白金製の50ccポットにガラス試料80gを入れて、電気炉中で各ガラスの熔融性の難易度に応じて、各試料を1100~1300℃の温度で2時間熔融した後、降温して各試料を1000℃、975℃および950℃で2時間保温した後、炉外に取り出して失透の有無を顕微鏡により観察したもので、その結果、失透が認められないガラスは○印で、また失透が認められたガラスは×印で示した。

【0020】

【表1】

単位；重量%

	実 施 例				
	1	2	3	4	5
SiO ₂	30.0	15.0		2.0	20.0
B ₂ O ₃	1.0	5.0	10.0	10.0	20.0
GeO ₂				10.0	
La ₂ O ₃	1.0	10.0	10.0	40.0	28.0
Lu ₂ O ₃	30.0	5.0	18.0	5.0	2.0
Y ₂ O ₃					
Gd ₂ O ₃				10.0	
Yb ₂ O ₃					
ZnO				1.0	5.0
MgO		3.0			
CaO	10.0		4.0		5.0
SrO		7.0			3.0
BaO	10.0		41.0		5.0
Al ₂ O ₃	1.0		5.0		0.5
TiO ₂	3.6	20.0	7.0		
ZrO ₂	6.5		3.0	2.5	7.5
Ta ₂ O ₅				18.5	
Nb ₂ O ₅	4.9	22.0		1.0	
WO ₃		3.0	1.0		
Li ₂ O	1.0		1.0		4.0
Na ₂ O		5.0			
K ₂ O		5.0			
Sb ₂ O ₃	1.0				
nd	1.665	1.876	1.741	1.856	1.692
vd	42.7	35.2	37.5	40.9	51.6
失透試験	1000℃	○	○	○	○
	975℃	○	○	○	○
	950℃	○	○	○	○

【表1】

単位；重量%

	実 施 例				
	6	7	8	9	10
SiO ₂		5.0		6.0	
B ₂ O ₃	20.0	25.0	28.0	30.0	45.0
GeO ₂			5.0		
La ₂ O ₃	17.0	50.0	20.0	23.5	29.0
Lu ₂ O ₃	3.0	0.5	20.0	1.5	1.0
Y ₂ O ₃	2.0		7.0	6.0	10.0
Gd ₂ O ₃	2.0				5.0
Yb ₂ O ₃	2.0	14.5	3.0		
ZnO				23.1	5.0
MgO					
CaO			5.0		
SrO					
BaO	6.5	1.0			
Al ₂ O ₃	2.5				
TiO ₂				0.1	
ZrO ₂		3.9		6.0	2.0
Ta ₂ O ₅					
Nb ₂ O ₅	40.0				
WO ₃			5.0		
Li ₂ O			5.0	3.3	3.0
Na ₂ O					
K ₂ O	5.0				
Sb ₂ O ₃		0.1	2.0	0.5	
nd	1.899	1.779	1.729	1.708	1.691
vd	38.0	47.7	52.5	48.9	56.8
失透試験	1000℃	○	○	○	○
	975℃	○	○	○	○
	950℃	○	○	○	○

【表1】

単位：重量%

	比較例		
	11	12	13
SiO ₂	2.0	20.0	
B ₂ O ₃	10.0	20.0	45.0
GeO ₂	10.0		
La ₂ O ₃	45.0	28.0	1.0
Lu ₂ O ₃			
Y ₂ O ₃			10.0
Gd ₂ O ₃	10.0	2.0	5.0
Yb ₂ O ₃			
ZnO	1.0	5.0	5.0
MgO			
CaO		5.0	
SrO		3.0	
BaO		5.0	
Al ₂ O ₃		0.5	
TiO ₂			
ZrO ₂	2.5	7.5	2.0
Ta ₂ O ₅	18.5		
Nb ₂ O ₅	1.0		
WO ₃			
Li ₂ O		4.0	3.0
Na ₂ O			
K ₂ O			
Sb ₂ O ₃			
nd	1.857	1.690	1.693
vd	40.9	51.8	56.9
失透試験	1000℃	○	○
	975℃	×	×
	950℃	×	×

【0021】表1に見られるとおり、本発明の実施例のガラスはいずれも前記所定の光学恒数を有している。また、Lu₂O₃を含有しない、No. 11～No. 13の比較例のガラスに比べ、これらのガラスはいずれも耐失透性に優れ、さらに均質化しやすい。このため前記実施例のガラスは製造が容易である。なお、本発明の表1記載の実施組成例のガラスは、いずれも酸化物、炭酸塩および硝酸塩等の通常の光学ガラス原料を用いて所定の割合で秤量混合した後白金坩堝に投入し、組成による溶融の難易度に応じて1000～1300℃の温度で2～4時間溶融し、攪拌均質化した後適当な温度に下げて金型等に鑄込み徐冷することにより容易に得ることができる。

【0022】

【発明の効果】以上述べたとおり、本発明の光学ガラスはB₂O₃-La₂O₃-Lu₂O₃-RO系の特定組成を有するものであるから、屈折率(nd)が1.65～1.90、アッベ数(vd)が35～65の範囲の光学定数と従来のガラスに比べて一段と優れた耐失透性を有するガラスが得られる。